

RECEIVED

JUN 04 2012

May 31, 2012

Chris Boe
Montana Department of Environmental Quality
Water Protection Bureau
P.O. Box 200901
Helena, MT 59620-0901

DEQ/WPB
PERMITTING & COMPLIANCE DIV.

JIP 6/4/12

RE: City of Bozeman Water Treatment Plant Discharge Permit MTX000224
Monitoring well installation reporting requirements.

Dear Mr. Boe:

This letter is to fulfill the reporting requirement under section E, No. 2 of the special conditions defined under discharge permit MTX000224. These wells were installed as part of the conditions of the permit to monitor water quality parameters defined in Permit Table #3. The special conditions of the discharge permit include installation of 3 monitoring wells and a written report on the installation of the monitoring wells. Please find the attached lithologic logs, driller logs (GWIC) and well location map.

Monitoring well installation

All three monitoring wells (MW1-A, MW2-A and MW3-A) were installed by Haggerty Drilling using a dual rotary rig and direct air rotary methods. Morrison-Maierle, Inc Geologist Pat Eller was on-site during well installation and directed Haggerty Drilling on final well completion. The monitoring wells were installed in accordance with the monitoring well plan submitted to the department on February 2, 2012, and approved on February 9, 2012. Well locations were staked in the field and final location of each monitoring well is as approved in the monitoring well plan.

MW1-A

MW1-A was completed by Haggerty drilling on May 10, 2012. The well was drilled by air rotary methods using a Foremost DR-24 dual rotary drilling rig. Six inch steel casing was advanced continuously while drilling to a total depth of 76 feet. Materials penetrated by the borehole included loam, sandy clay loam and gravel. Water was first encountered at approximately 63 feet. The well was screened with 2-inch factory slotted pvc from 50 to 76 feet. The screen was sand packed with 10-20 silica sand as the casing was pulled back. Well grout consisted of bentonite chips from 46 feet to ground surface as the 6-inch steel casing was pulled back. Six inch case extends from 4 feet above ground surface to 3 feet below ground surface. Both the 2-inch well casing and the 2-inch well screens were equipped with centralizers. The well was developed using a 1 ½' bailer. The well was disinfected on May 29, 2012.

MW2-A

MW2-A was completed by Haggerty drilling on April 30, 2012. The well was drilled by air rotary methods using a Foremost DR-24 dual rotary drilling rig. Six inch steel casing was advanced continuously while drilling to a total depth of 93 feet. Materials penetrated by the borehole included loam, loamy sand, sandy clay loam and gravel. Water was first encountered at approximately 60 feet. The well was screened with 2-inch factory slotted pvc from 48 to 93 feet. The screen was sand packed with 10-20 silica sand as the casing was pulled back. Well grout consisted of bentonite chips from 44 feet to ground surface as the 6-inch steel casing was pulled back. Six-inch case extends from 2 feet above ground surface to 3 feet below ground surface. Both the 2-inch well casing and the 2-inch well screens were equipped with centralizers. The well was developed using a 1 ½' bailer.

MW3-A

MW3-A was completed by Haggerty drilling on April 30, 2012. The well was drilled by air rotary methods using a Foremost DR-24 dual rotary drilling rig. Six inch steel casing was continuously advanced while drilling to a total depth of 68 feet. Materials penetrated by the borehole included loam, loamy sand, sandy clay loam, gravel and metamorphic bedrock. The contact between the alluvial material and the metamorphic bedrock was 65 feet below ground surface. Once bedrock was encountered, drilling was halted, the casing was pulled back and the gravel was developed with air. The gravel was determined to be drained out at this location, and drilling commenced openhole into the bedrock. Water was first encountered in a fracture set at 105 feet. Drilling proceeded to 135 feet with no increase over the initial yield of approximately 2 gpm encountered in the fracture at 105 feet.

The well was completed across the fracture within the metamorphic bedrock. The well was screened with 2-inch factory slotted pvc from 100 to 120 feet. The screen was sand packed using 10-20 silica sand as the casing was pulled back. Well grout consisted of bentonite chips from 90 feet to ground surface as the 6-inch steel casing was pulled back. Six-inch case extends from 2 feet above ground surface to 3 feet below ground surface. Both the 2-inch well casing and the 2-inch well screens were equipped with centralizers. The well was developed using a 1 ½' bailer. The well was disinfected on May 29, 2012.

Final Well Completions

Bollards were installed surrounding wells MW2-A and MW3-A to provide protection from physical damage. Bollard installation at MW1-A is planned to be completed upon establishment of final grade at the well site. All three wells are equipped with locking well caps. Wellhead elevations were surveyed after completion and are included on the attached lithologic logs.




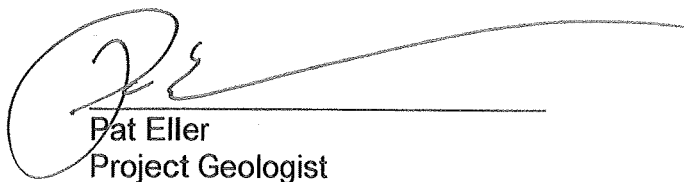
Sampling

Sampling and reporting requirements of the discharge permit will be provided by City of Bozeman personnel and will follow the conditions of the permit.

If you have any questions or comments on the completion of the monitoring wells or this report please feel free to reach me at (406) 922-6769 or neller@m-m.net.

Sincerely,

 MORRISON-MAIERLE, INC.



Pat Eller
Project Geologist

Enclosure

cc: Rick Moroney, City Water Treatment Plant Superintendent
Bob Murray, City Engineering – Email Copy
Dan Harmon, HDR Engineering – Email Copy

N:\2105\057\Discharge Permit\Monitoring well report.docx

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Other Options

Plot this site on a topographic map

Section 7: Well Test Data

Total Depth: 76
Static Water Level: 54
Water Temperature:

Air Test *

3 gpm with drill stem set at 71 feet for 1 hours.
Time of recovery 1 hours.
Recovery water level 54 feet.
Pumping water level feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

MW1A

Section 9: Well Log

Geologic Source

Unassigned

Township	Range	Section	Quarter Sections
03S	06E	6	SE¼ SE¼ SE¼
County			Geocode

Latitude	Longitude	Geomethod	Datum	
59886635345	111.021832054	TRS-SEC	NAD83	
Ground Surface Altitude		Method	Datum	Date

Addition	Block	Lot
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MONITORING (1)

Drilling Method: ROTARY

Date well completed: Thursday, May 10, 2012

Borehole dimensions

From	To	Diameter
0	76	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-3.5	3	6	0.25		WELDED	A53B STEEL
-3	50	2			FLUSH THREAD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
50	76	2		.020	SCREEN-CONTINUOUS-PVC

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: KEVIN HAGGERTY

Company: KEVIN HAGGERTY DRILLING INC

License No: MWC-94

Date _____

Completed: 5/10/2012

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
-1.5	0	BENTONITE	Y
0	46	BENTONITE	Y
46	76	10-20 SAND	Y

Other Options

Plot this site on a topographic map

Total Depth: 93
Static Water Level: 52
Water Temperature:

Air Test *

1 gpm with drill stem set at 88 feet for 1 hours.
Time of recovery 1 hours.
Recovery water level 52 feet.
Pumping water level feet.

* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.

Section 8: Remarks

MW2A

Section 9: Well Log

Geologic Source

Unassigned

[illegible]

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: KEVIN HAGGERTY
Company: KEVIN HAGGERTY DRILLING INC
License No: MWC-94
Date Completed: 4/30/2012

SiteSummary.asp?gwicid=265702&age... 5/24/201

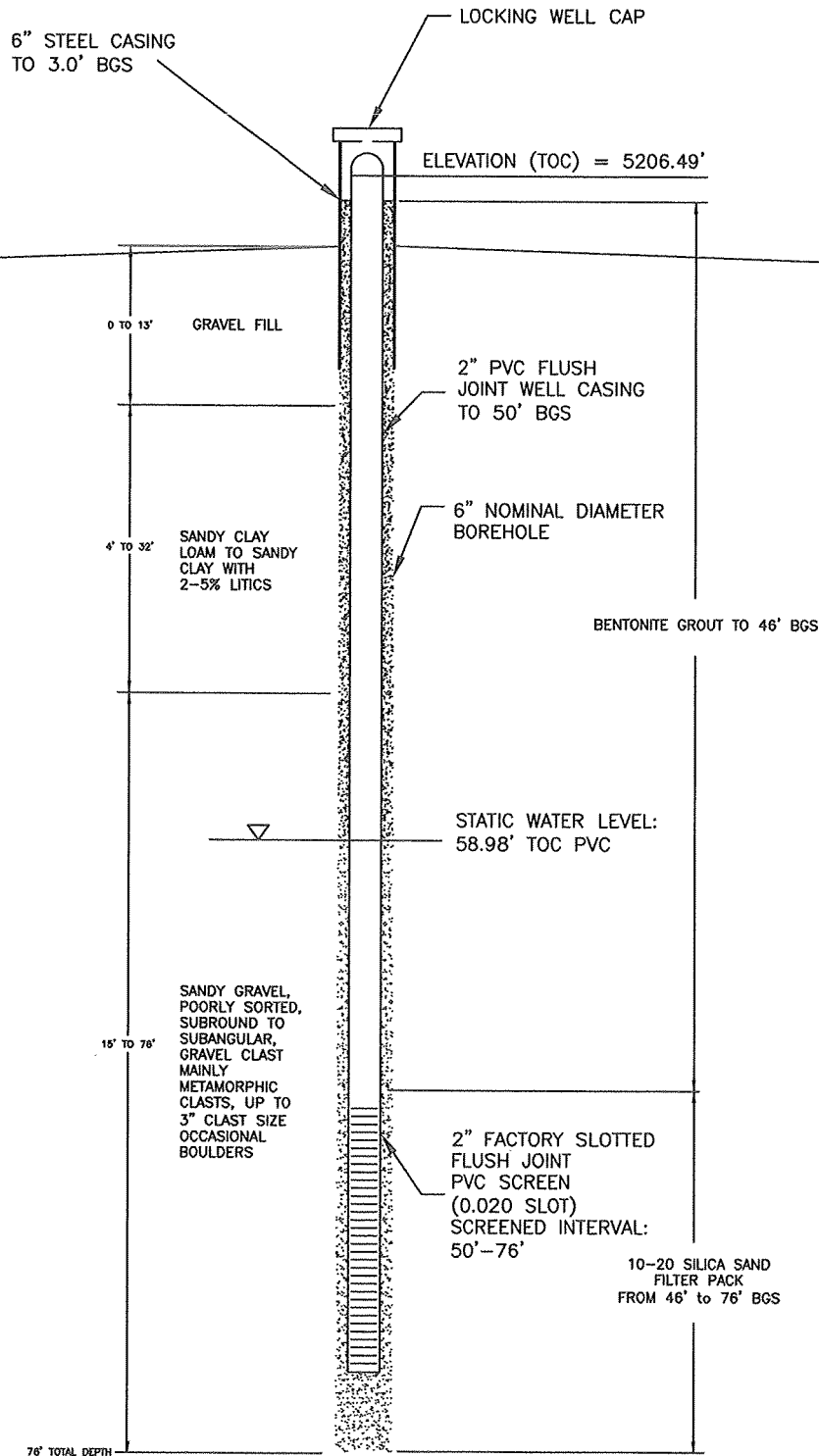
bioRxiv preprint doi: <https://doi.org/10.1101/2019.07.21.269401>; this version posted July 21, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY-NC-ND 4.0 International license.

48	88	2		.020	SCREEN-CONTINUOUS-PVC
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Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
-1.5	0	BENTONITE	Y
0	44	BENTONITE	Y
44	93	10-20 SAND	Y

Name: KEVIN HAGGERTY
Company: KEVIN HAGGERTY DRILLING INC
License No: MWC-94
Date Completed: 4/25/2012



**MORRISON
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ENGINEERS
SCIENTISTS
SURVEYORS
PLANNERS
SINCE 1945

PO Box 1113, 2880 Technology Blvd West, Bozeman, MT 59711 Phone (406) 587-0721

CLIENT: City of Bozeman

FIELD WORK: NPE

DRAWN BY: NPE

CHECKED BY: NPE

DATE: 05/24/12

SCALE: NTS

PROJ #: 2105.057

Monitoring well
MW-1A

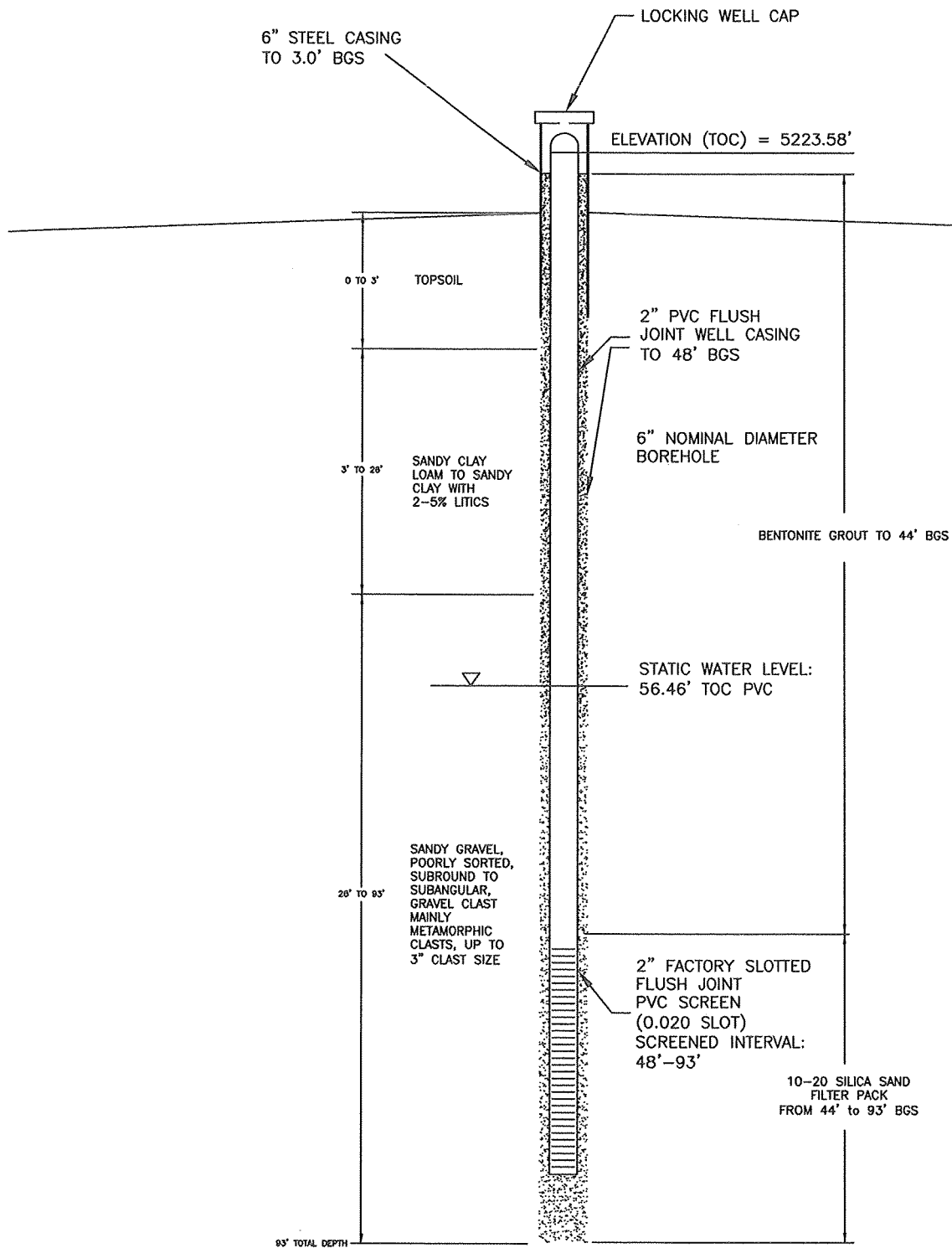
COB Water Treatment Plant

PLOTTED DATE: May/31/2012 - 04:45:52 pm

DRAWING NAME:

N:\2105\057\Acad\Exhibits\Drainfield\MW-3a.dwg

SHEET 3 OF 3 PLOTTED BY: neller



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SINCE 1945

PO Box 1113, 2880 Technology Blvd West, Bozeman, MT, 59711 Phone: (406) 587-0721

CLIENT: City of Bozeman

FIELD WORK: NPE

DRAWN BY: NPE

CHECKED BY: NPE

DATE: 05/24/12

SCALE: NTS

PROJ #: 2105.057

Monitoring well
MW-2A

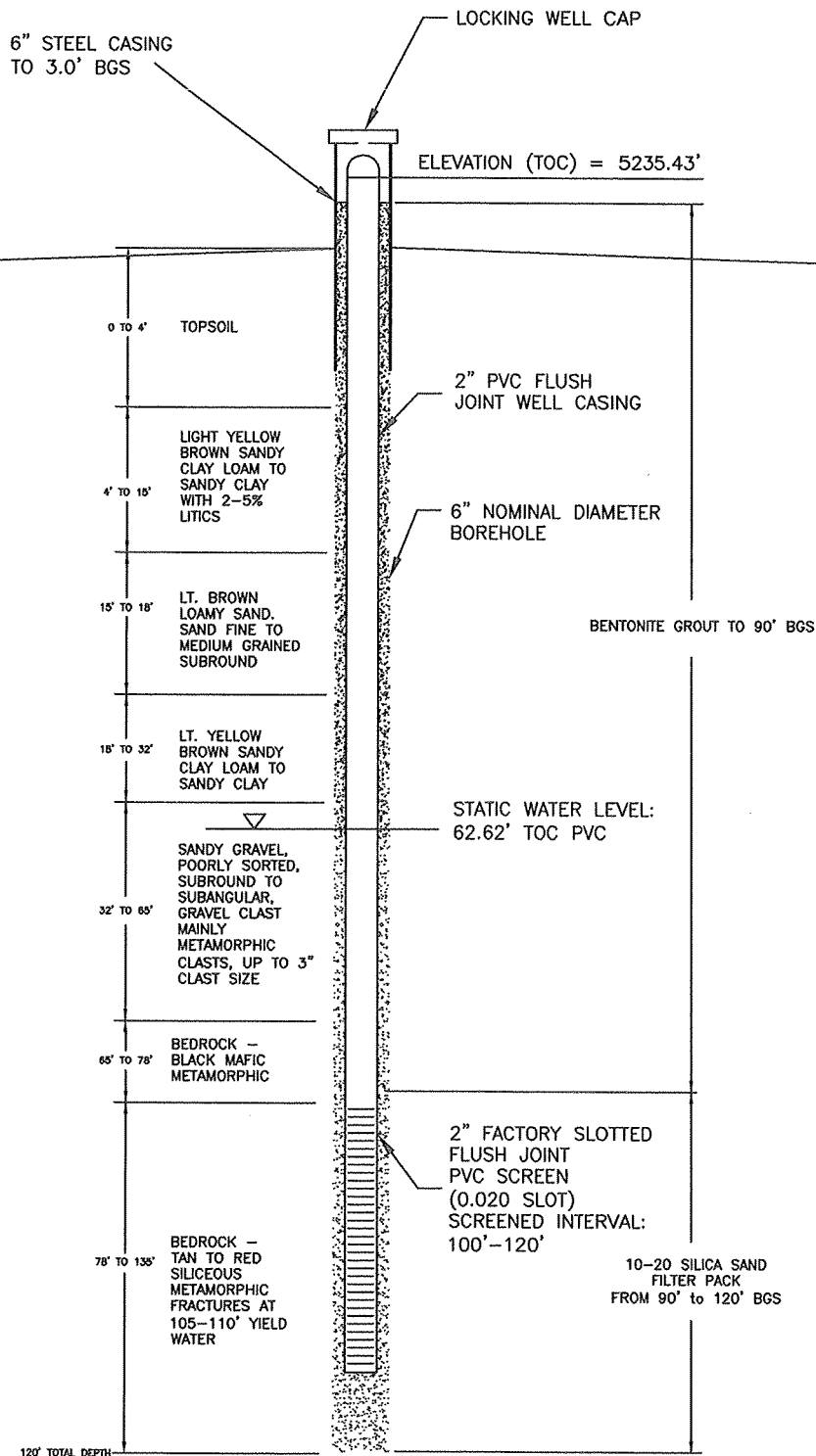
COB Water Treatment Plant

PLOTTED DATE: May/31/2012 - 04:46:11 pm

DRAWING NAME:

N:\2105\057\Acad\Exhibits\Drainfield\MW-3a.dwg

SHEET 2 OF 3 PLOTTED BY: neller



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PO Box 1113, 2880 Technology Blvd West, Bozeman, MT 59711 Phone: (406) 587-0721

CLIENT: City of Bozeman

FIELD WORK: NPE

DRAWN BY: NPE

CHECKED BY: NPE

DATE: 05/24/12

SCALE: NTS

PROJ #: 2105.057

Monitoring well
MW-3a

COB Water Treatment Plant

PLOTTED DATE: May/31/2012 -- 04:46:23 pm

DRAWING NAME:

N:\2105\057\Acad\Exhibits\Drainfield\MW-3a.dwg

SHEET 3 OF 3 PLOTTED BY: neller